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FUTURE WATER QUALITY AND POLLUTION PROBLEMS

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INTRODUCTION

An earlier brief entitled "Past and Present Water Quality" described how water quality in San Francisco Bay has changed during the last two centuries. This brief describes the changes that might take place in the future and what can be done about them.

A number of conclusions, with implications for the water-oriented elements of the EMP have been drawn and are presented for EMTF consideration and action.

RECOMMENDED EMTF ACTION

Staff recommend that EMTF approve the following conclusions. The conclusions are drawn from the material presented in the brief and from the analysis that supports it.

- The link between pollutant sources and their effects on the Bay is not well understood.
- Total wastewater flows and certain pollutant loads will increase between 1975 and 2000.
- Unless remedial action is taken several beneficial uses of the region's waters (fishery propagation, recreation, etc.) will continue to be impaired.
- Preliminary analysis indicates that the most cost-effective ways of further reducing waste loads are to increase controls on indirect industrial discharges and surface runoff.

Staff recommend that EMTF take the following actions.

- Direct staff to identify as part of the continuing planning process those studies necessary to answer questions regarding pollutant sources and their effects on the Bay ecosystem.
- Direct staff to emphasize surface runoff controls and pre-treatment of industrial discharges to municipal sewers in the appropriate management plans. Planning effort should initially focus on those controls that reduce pollutant loads at a minimum cost.

*See revised
version
in file*

- Direct staff to establish a procedure for updating the management plans when the results of pollution cause-and-effect studies are complete.
- Refer the matter of administration of surface runoff pollution control programs to the Plan Implementation Committee.

FUTURE WATER QUALITY AND POLLUTION PROBLEMS

Unlike the earlier discussion of past and present water quality, consideration of future water quality is speculative. There is no large body of factual information supporting the predictions. However, if we are to manage the water resources of the region in a responsible way, it is essential that predictions be made. The material contained in the brief summarizes the results of our estimates of future water quality which were made with the best predictive tools available.

Because the matters being discussed are complicated, the material contained in this brief is presented in a question and answer format. In this way, it is hoped, the essential features of a rather complex argument are made to stand out clearly.

For the sake of completeness we need to begin by answering the question. . . .

What is pollution?

Despite the fact that "pollution" has been a much-used term in the last few years, its definition remains somewhat elusive. Pollution can be defined as "impairment of a desired beneficial use" or more simply as a "damaging excess." The Federal Water Pollution Control Act Amendments circumvent philosophical discussion and simply define "pollutant" rather unhelpfully as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water."

For the purpose of the EMP the definition of pollution as "impairment of a desired beneficial use" appears most workable. Previous work reported on in the Water Quality Control or Basin Plan defined existing and potential beneficial uses for the waters of the region.^a Thus our working definition of pollution is anything that prevents these beneficial uses from occurring either now or in the future.

^a "Water Quality Control Plan for San Francisco Bay Region", SWRCB, 1945

Are the waters of the region polluted?

Yes. In an earlier brief the historical trend of water quality in the Bay was described. This trend is illustrated in Figure 1. As the Bay Area was settled and industry and commerce expanded, water quality declined. The decline continued until the 1950's at which time remedial measures began to be applied. Water quality in the Bay today is much improved compared to conditions in the early part of this century. This is not to say, however, that Bay waters are now unpolluted. Many beneficial uses, particularly those relating to shellfish harvesting remain impaired. Although the gross effects of pollution evident in the vicinity of municipal and industrial discharges have been or are being eliminated, the subtler effects remain. Fishkills continue to occur in many parts of the Bay. Metal and organic compound concentrations in shellfish make them undesirable for human consumption. Litter and oil and grease mar the shorelines after rainstorms.

Unlike the Bay and some of its tributary streams the Pacific Ocean does not exhibit signs of pollution or impaired beneficial uses.

Which water quality standards are violated and which beneficial uses are impaired?

The Water Quality Control Plan for the San Francisco Bay Region identifies existing and potential beneficial uses of the Bay as follows:

- industrial service supply
- navigation
- water-contact recreation
- non-water-contact recreation
- commercial and sport fishing
- wildlife habitat
- preservation of rare and endangered species
- marine habitat
- fish migration
- fish spawning
- shellfish harvesting

The same plan includes water quality standards that are intended to protect these beneficial uses.

At present some of these beneficial uses are impaired. Water contact recreation is impaired by high bacteria concentrations close to the shoreline particularly after rainstorms. Fisheries are impaired by oxygen depletion in the South Bay and in sloughs receiving wastewater discharges and by unexplained toxic factors that lead to fish kills. The Dungeness crab fishery has declined sharply in recent years. Shellfish harvesting is impaired by high

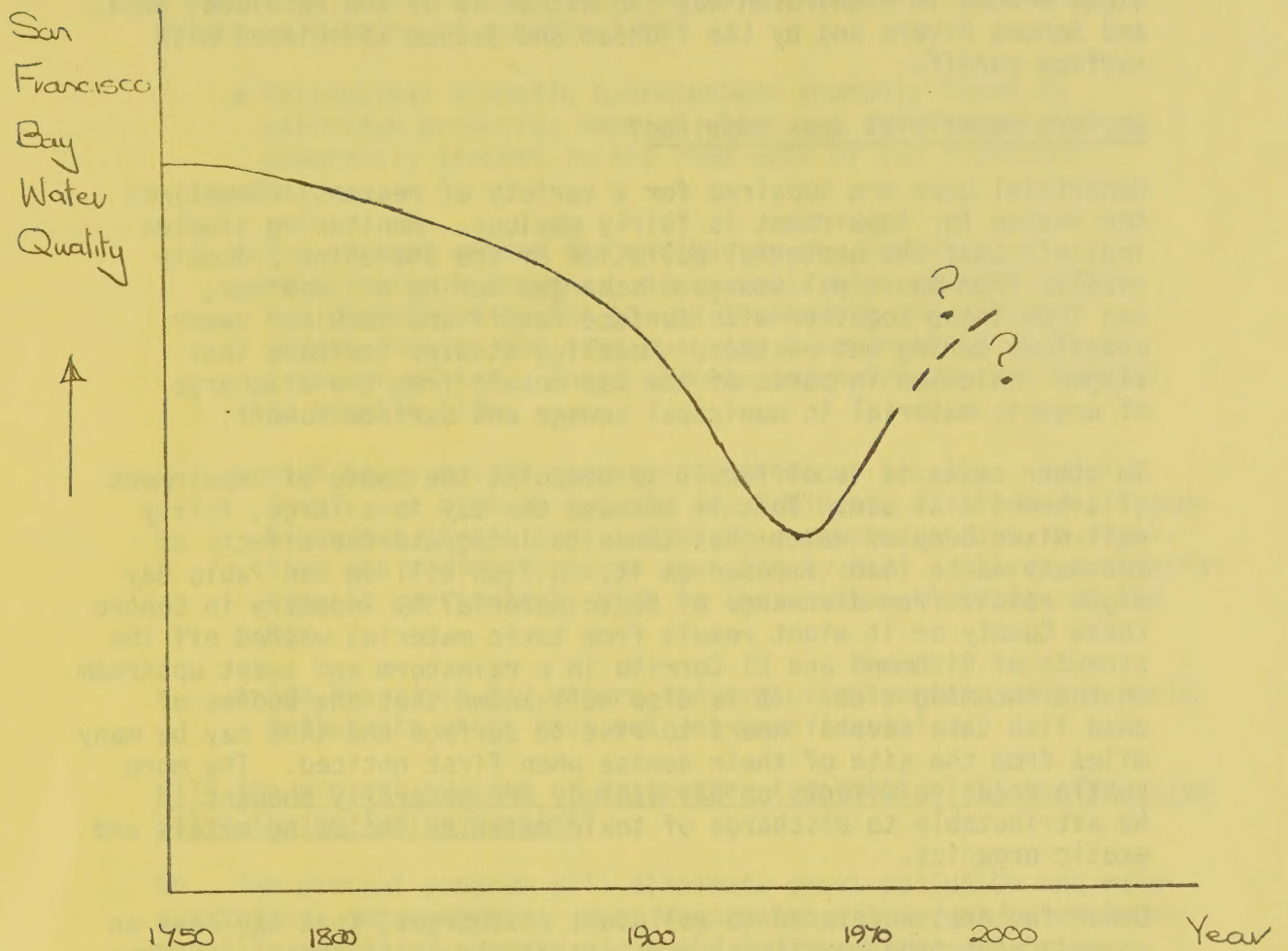


Fig 1 S.F. Bay Water Quality - Historical Trend

bacteria concentrations and by high metals and organic compound concentrations in some areas. Recreation based on aesthetic satisfaction is impaired by unsightly and occasionally odoriferous algae blooms in Richardson Bay and estuaries of the Petaluma, Napa, and Sonoma Rivers and by the flotsam and jetsam associated with surface runoff.

Why are beneficial uses impaired?

Beneficial uses are impaired for a variety of reasons. Sometimes the reason for impairment is fairly obvious. Monitoring studies indicate that the bacterial pollution of the shoreline probably results from municipal sewage discharges during dry weather, and from these together with surface runoff and combined sewer overflows during wet weather. Modeling studies indicate that oxygen depletion in parts of the bay result from the discharge of organic material in municipal sewage and surface runoff.

In other cases it is difficult to pinpoint the cause of impairment of a beneficial use. This is because the bay is a large, fairly well-mixed body of water that tends to integrate the effects of the many waste loads imposed on it. A fish kill in San Pablo Bay might result from discharge of toxic material by industry in Contra Costa County or it might result from toxic material washed off the streets of Richmond and El Cerrito in a rainstorm and swept upstream on the incoming tide. It is also well-known that the bodies of dead fish take several hours to rise to surface and thus may be many miles from the site of their demise when first noticed. The more subtle negative effects on bay ecology are generally thought to be attributable to discharge of toxic material including metals and exotic organics.

Other factors, unrelated to pollutant discharges, that may have an adverse effect on beneficial uses, particularly fisheries, are the reduction in freshwater outflow to the bay from the Sacramento/San Joaquin Delta and the filling of shallower portions of the bay.

Does evidence exist that toxicants are adversely affecting aquatic life in the bay?

The Lawrence Berkeley Laboratory under contract with the Regional Water Quality Control Board and ERDA have been conducting studies of heavy metals concentrations in the bay and their effect on aquatic life for several years. The studies show that the concentrations of dissolved copper and cadmium that are found in south bay waters are approaching levels at which acute toxic effects on the Pacific Oyster are observed. Further studies on silver and zinc concentrations and their effects on oysters, herring and anchovy are in progress. High silver concentrations are known to exist in the south bay. (Personal communication, Donald C. Girvin, LBL.)

A special study report prepared for the EMP by consultant R. W. Risebrough also addresses this question. The report makes a number of points which give rise to some concern for the continued well-being of aquatic life.

- Polynuclear aromatic hydrocarbons commonly found in petroleum products, some of which are carcinogens are apparently present in the food webs of San Francisco Bay.
- The present method for estimating the quantity of chlorinated hydrogens, e.g., certain pesticides, that are discharged to the bay is inadequate and probably underestimates the true quantity discharged by at least a factor of ten. These chlorinated hydrogens are harmful to aquatic life.
- High heavy metals concentrations occur locally. Cadmium levels are high in mussels and sediments of the Mare Island-Carquinez Strait area. High lead concentrations in shellfish and sediments occur near Albany Hill. Silver contamination is particularly high in the southwest portion of the bay.
- San Francisco Bay waters and organisms contain many organic pollutants which have not yet been identified.

Will the present program of wastewater treatment plant construction solve the pollution problem?

No. The present program will eliminate gross pollution and make substantial improvements. Many wastewater discharges to environmentally sensitive sloughs along the bay shoreline are being eliminated and replaced by discharges to deeper waters. Higher levels of treatment remove much of the organic material that continues to cause oxygen depletion in the southern extremity of the bay. Although the more subtle effects of pollution may be reduced somewhat by the present program they will not be eliminated.

Why not?

The present program of wastewater treatment plant construction will not solve the pollution problem for two reasons. First, the types of treatment and dispersion systems being built are not effective in dealing with the substances, metals for example, that are believed to be the cause of the more subtle pollution effects. Second, the present program does not attempt to control surface runoff from urban areas, the probable source of many of the substances in question.

Is it possible to predict future water quality conditions?

Yes. Although our understanding of the reaction of the environment to introduced pollutants is imperfect, reasonable estimates of future water quality can be made.

Predictions can be made in two ways. First and more simply by an analysis of the likely trend in waste loads applied to the bay. Secondly, by mathematically simulating the bay and its water quality interactions. The analyses undertaken to date have used the first method. Mathematical modeling of water quality is in progress. It should be noted however that toxicants cannot be modeled effectively.

What are the likely trends in waste loads discharged to the waters of the region?

It is expected that the waste loads discharged to the waters of the region will vary with time as shown in Figure 2. The total wastewater flow from municipal and industrial sources is likely to increase about 30 percent between 1975 and 2000. During the same period biochemical oxygen demand and suspended solids from these sources will decrease by 70 percent and 45 percent respectively.

Surface runoff flows will increase by 6 percent between 1975 and 2000 as more of the land surface is developed. More precise estimates of the pollutant loads from surface runoff will be made when the latest county progress reports have been compiled.

What will conditions be in the future?

Based on an analysis of the trend in waste loads it is possible to predict future water quality conditions in the bay. The oxygen depletion and nutrient enrichment problems evident in parts of the bay are likely to recede as total waste loads of organic material and nutrients are reduced. Bacterial contamination during dry weather will also decrease.

Continued discharge of metals and other toxicants at the present or perhaps somewhat increased levels suggests that the subtler pollutional effects attributable to them will probably continue.

Will future pollution be serious enough to justify remedial action?

This question cannot be answered conclusively at this time. There is no doubt that some beneficial uses will be impaired if no remedial action is taken. The cost of remedial action may be high, however.

To answer the question it is necessary to estimate the cost of remedial measures and to compare this to the benefits of the investment.

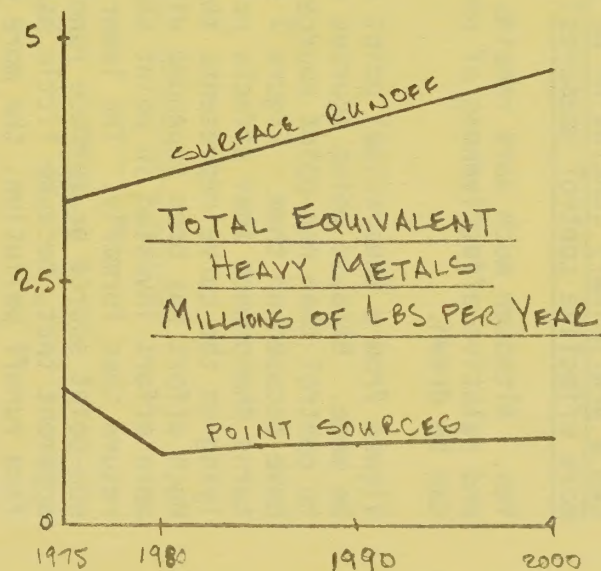
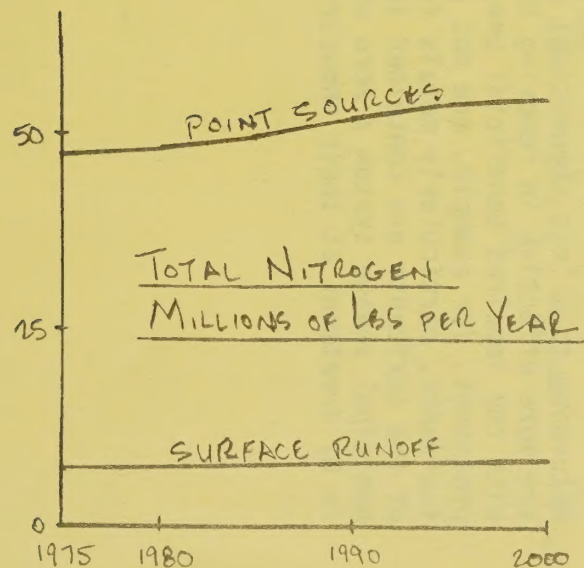
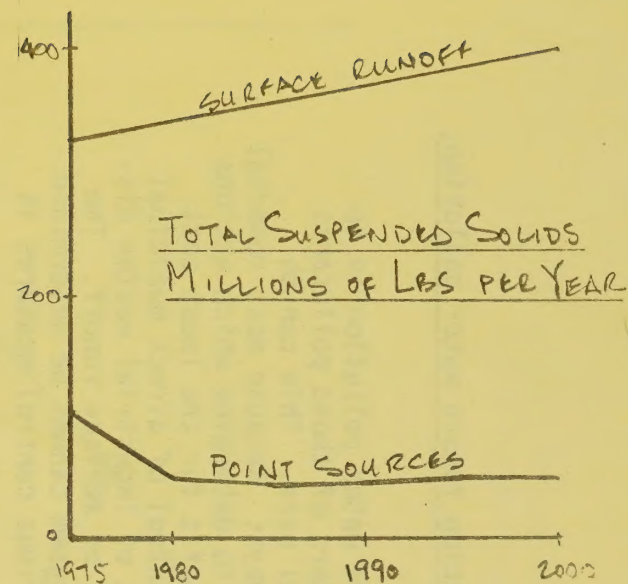
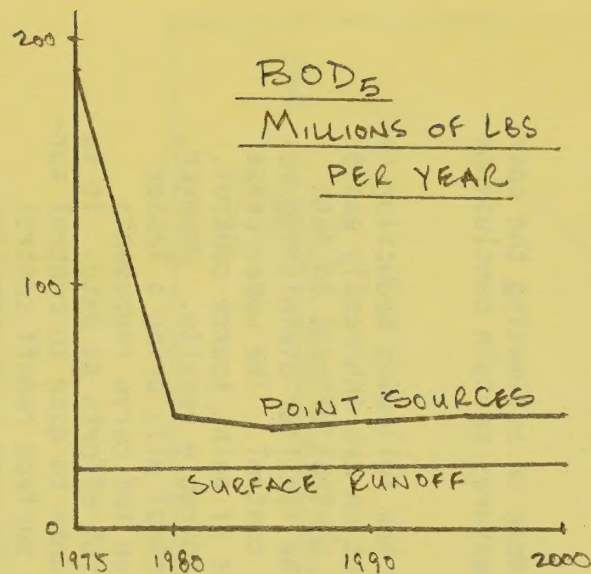
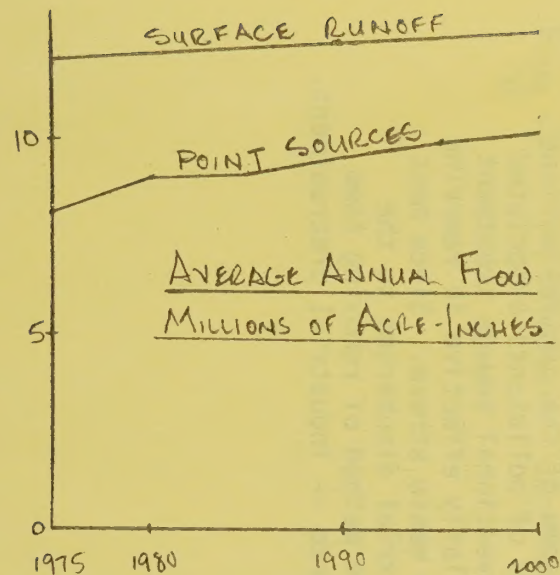


FIGURE 2

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ESTIMATED VALUES FOR
WASTE DISCHARGE PARAMETERS
SAN FRANCISCO BAY REGION
1975 - 2000

NOTES:

1. "POINT SOURCES" = MUNICIPAL + INDUSTRIAL DISCHARGES
2. "TOTAL EQUIVALENT HEAVY METALS" IS A WEIGHTED SUMMATION BASED ON METAL TOXICITIES. SEE WQ TECH MEMO #7, 2-24-77.

Assuming a commitment is made to preventing future water pollution, what should be done?

The most promising way to prevent future water pollution is to further reduce the input to surface waters of those pollutants responsible for impairment of beneficial uses. This can be accomplished in a number of different ways. Because most remedial actions are expensive, it is necessary to determine which actions will produce the most environmental benefit for the least cost. Actions could include more stringent control of direct municipal and industrial discharges, pretreatment of industrial wastes discharged to municipal systems or control of surface runoff. The exact make-up of a complete control program cannot be determined until a more thorough assessment of various control measures is completed.

Can a preliminary conclusion be drawn about what appear to be the more effective control measures?

Yes. Although much work remains to be done on estimating the cost and relative effectiveness of control measures certain conclusions can be drawn.

Viewed from a theoretical point of view the following deduction can be made. Because point sources of pollution are inherently easier to control than non-point sources, most control efforts to date have focused on them. Figure 3 shows the familiar diminishing returns phenomenon that affects pollution control. The upper cross lying on the curve represents the status of point source control. Much effort has been expended with considerable results. However, more effort invested in point source control will bring a lesser return than formerly. The lower cross on the curve represents non-point source or surface runoff control efforts to date. It is apparent that, because little has been done to date to control surface runoff pollution, the more obvious surface runoff control measures have the potential at least to be more cost-effective than further point source control.

Returning to a less theoretical plane, some of the control actions are more effective in removing the types of pollutants associated with the impaired beneficial uses. Conventional sewage treatment processes, for example, are not particularly effective in removing toxicants, particularly metals from the waste stream. Since most of the toxicants are contained in industrial discharges to the municipal sewage system a more effective method of removing them is by treatment at their industrial source -- industrial pretreatment.

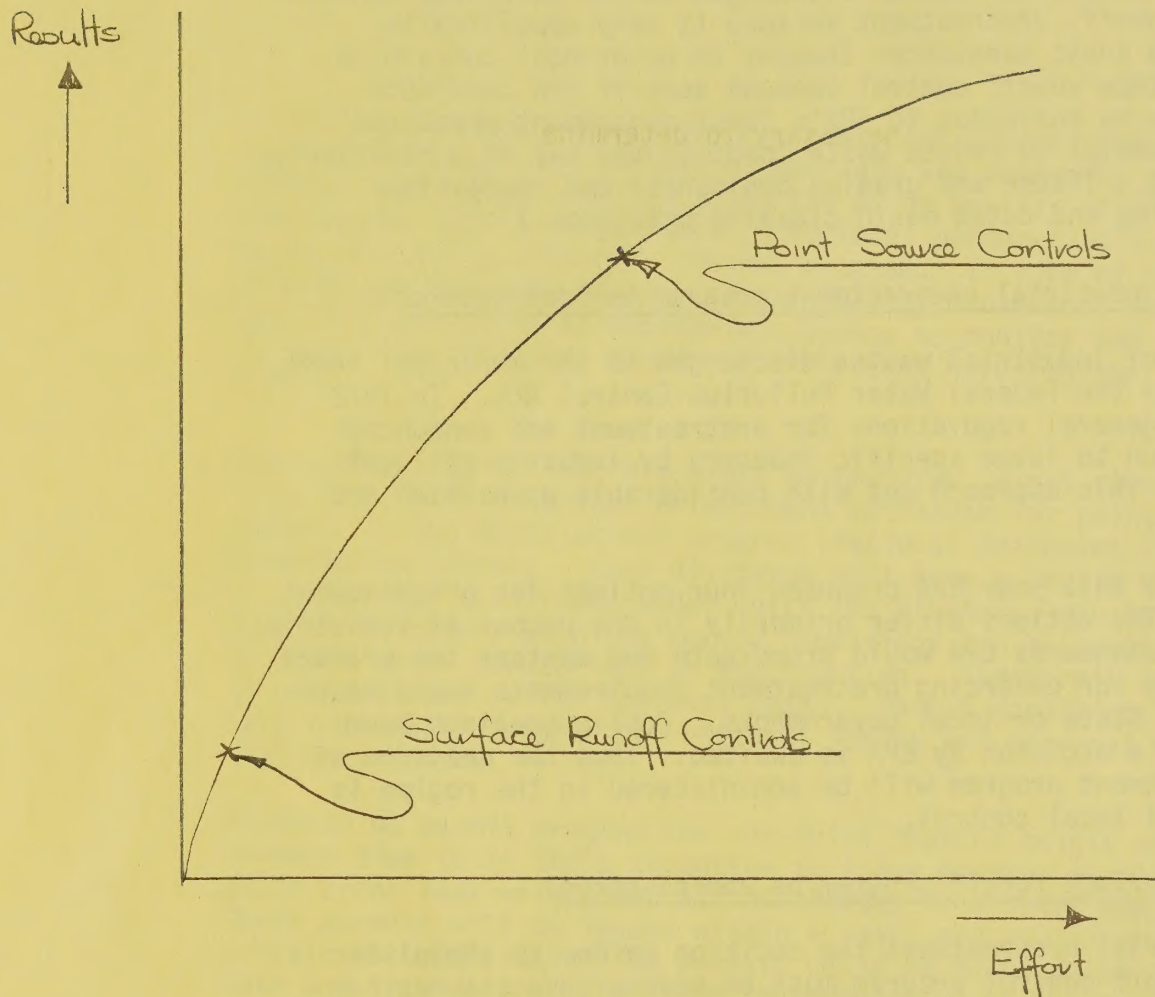


Fig 3 Pollution Control - Diminishing Returns Phenomenon

Surface runoff control measures that reduce the availability of pollutants for wash-out in storms, street-sweeping for example, are also effective.

In conclusion, the two most promising actions appear to be pre-treatment of industrial wastes discharged to the sewer and control of surface runoff; pretreatment because it very specifically addresses the toxic substances thought to be of most concern in the bay; surface runoff control because some of the candidate control measures analagous to EPA's "best management practices" have the potential to reduce waste loads to the bay at a relatively low cost (e.g., litter and grading ordinances and reorganized street-sweeping and catch basin cleaning practices.)

How might an industrial pretreatment program be administered?

Pretreatment of industrial wastes discharged to the municipal sewer is required by the Federal Water Pollution Control Act. In 1973 EPA proposed general regulations for pretreatment and announced their intention to issue specific industry by industry effluent limitations. This approach met with considerable opposition and was withdrawn.

In February of this year EPA proposed four options for pretreatment regulation. The options differ primarily in the number of industrial pretreatment standards EPA would promulgate and whether the primary responsibility for enforcing pretreatment requirements would rest with Federal, State or local governments. Public hearings have been held and a decision by EPA is awaited. Thus the decision of how a pretreatment program will be administered in the region is largely out of local control.

How might a surface runoff program be administered?

Unlike industrial pretreatment the decision on how to administer a surface runoff control program must be made within the region.

As noted earlier, the Bay tends to integrate the effects of all pollutant loads applied to it. The pollutants contained in the effluent from Contra Costa County's wastewater treatment plants may, six hours after discharge, be affecting the marshes of Solano County or the Marin County shoreline. Recognition of the fact that effective water quality planning and management must be conducted with a broad perspective led to the creation of the Regional Water Quality Control Boards more than twenty-five years ago, although at that time only point source controls were contemplated. The substantial improvements in water quality that have occurred in the last twenty-five years are due, at least in part, to the Board's ability to direct effort and funds to those sewage treatment projects which will benefit the region as a whole.

A similar argument can be made for non-point source control. Pollutants washing off the streets of San Jose and Sunnyvale may, several hours later, be degrading the water quality of the San Mateo and Alameda County shorelines. A regional perspective is necessary to administer an effective control program. In view of the present role of the Regional Board in water quality management it appears that they are the most appropriate agency to monitor and enforce at least those surface runoff controls that have regional implications.

How surface runoff controls might be enforced is not clear at this time. The principal enforcement mechanism for point source control is the NPDES permit program (National Pollutant Discharge Elimination System). Each discharge must have a permit which describes the conditions under which the discharge can be made. Failure to comply with the permit conditions can be penalized by fines or by moratoriums on construction. The permit program is administered by the Regional Board. Permit conditions reflect both nationally established effluent limits and regional water quality concerns.

Although no permit program for non-point sources exists at the present time it is EPA's intention to issue general permits for urban areas that will cover all discharges from storm sewers. These permits will be issued within a year, and will initially contain no conditions. The permits could be reissued at a later date and be made conditional on implementation of the surface runoff control measures contained in the EMP. Although many details remain to be worked out this appears to be one way surface runoff pollution could be effectively managed.

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